APPARATUS FOR GASIFICATION OF COMBUSTION AND WASTE MATERIALS CONTAINING CARBON AND ASH

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a device for utilizing combustion and waste materials containing carbon and ash by means of gasification.

The device can be used wherever waste materials containing carbon and ash are gasified with oxygen or an oxidizing agent containing oxygen at increased or atmospheric pressure in a flame reaction at temperatures of at least 1100° C.

2. Description of the Related Art

Combustion materials containing ash include solid fuels with greater or lesser ash content, such as brown coal and hard coal and their cokes, as well as oil and tars slightly loaded with inorganic components and mixtures thereof with solids. Waste materials containing ash include solids and liquids found in the waste and recycling industry, in particular, such as communal and industrial sludges, used oils, oils containing PCBs, plastic and household waste fractions and their processing products, light shredder from the processing of auto, cable and electronic scrap, and contaminated aqueous solutions.

In gas production technology, the autothermal fluidized gasification of solid, liquid and gaseous combustion materials has been known for years. The ratio of combustion material to gasification agents containing oxygen is selected in such a way that, for reasons of synthesis gas quality, the higher carbon compounds are completely cracked into synthesis gas components such as CO and H_2, while the inorganic components are extracted as molten slag (see, i.e., J. Carl, P. Fritz, *Noell-Konversion-Verfahren,* EF Verlag fuer Energie- und Umwelttechnik GmbH, 1996, p. 39).

In various known systems the gasification gas and the molten slag can be extracted separately or jointly from the reaction chamber of the gasification device (see, i.e., F. J. Schweitzer, *Thermoselect-Verfahren,* EF Verlag fuer Energie- und Umwelttechnik GmbH 1994, p. 156).

German reference 4446803 A1 discloses that refractory-grade lined systems or cooled systems can be provided as the interior border for the reaction chambers of gasification systems.

Gasification systems equipped with refractory-grade linings have the advantage of lower heat losses, and thus provide energy-efficient conversion of the supplied combustion materials. However, such systems can be used only for ash-free combustion materials, because the molten slag that flows down the interior surface of the reaction chamber during the fluidized gasification process dissolves the refractory-grade lining. This means that only limited reactor runs are possible before costly relining becomes necessary.

To overcome this disadvantage, cooled systems based on the principle of a membrane wall have been created for combustion materials containing ash. The cooling initially causes a solid slag layer to form on the surface associated with the reaction chamber. The thickness of the solid slag layer increases until further slag ejected from the gasification area runs down this wall as a liquid and flows out of the reaction chamber, e.g., together with the gasification gas. Such systems are highly resistant and ensure long reactor runs. A substantial disadvantage of these systems, however, is that up to roughly 5% of the furnished energy is transferred to the cooled screen and is available only in the form of hot water or low-pressure steam. This can be a considerable disadvantage, especially in the case of low-caloric combustion materials and waste materials.

Various combustion and waste materials (e.g., oils containing heavy metals or light ash, tars and tar-oil-solid sludges) contain too little ash to form an adequate protective slag layer on the cooled reactor walls. This, too, leads to energy losses. On the other hand, in reactors with refractory-grade linings, the ash content of such materials is too high to avoid the melting or dissolution of the refractory-grade layer or to achieve sufficiently long reactor runs before re-lining is necessary.

SUMMARY OF THE INVENTION

Accordingly, the object of the invention is to provide a gasification apparatus that can use combustion and waste materials that have a wide variety of ash contents.

The device according to the invention is suitable not only for the gasification of combustion and waste materials with a wide variety of ash contents, but also for the combined gasification of gasses, liquids and solids containing hydrocarbons.

According to the invention, the contour of the reaction chamber for the gasification process, which can involve a fluidized reactor or a fixed bed reactor, is bordered in part by a refractory-grade lining and in part by a cooled screen.

The reactor should be suitable for pressures between ambient pressure and 60 bar, preferably between ambient pressure and 30 bar. The refractory-grade lining can encompass the cylindrical part of the reactor space or parts thereof as well as the floor of the reactor space. The part not consisting of refractory-grade material consists of an intensively cooled contour with a ceramic coating. The scope of the area to be cooled is based on the quantity of molten slag that accrues.

The cooled area is formed by single-plex or multi-plex wound coils, through which cooling water flows at high speed and at a pressure that exceeds the gasification pressure. The cooling coils can be operated, while being cooled by pressurized water, above or below the boiling point of the cooling water. The cooling coils are attached to the sides of the reaction chamber by studs and coated with a ceramic mass that conducts heat well. The good cooling allows molten slag to solidify on this mass, so that a slag cover develops on which slag that is still molten can flow down. As a result, the cooling coils are reliably protected, even against corrosive attacks.

Instead of a screen of pipes connected in a gas-tight fashion, a double-mantle design with a cooling space can be used. Furthermore, it is advantageous to design the cooling system so that the outlet opening and the floor can be cooled either in series with or parallel to the cylindrical mantle of the apparatus. The cooling system of the cylindrical reaction chamber contour can be expanded upward easily. It is also advantageous to design the joint between the refractory-grade material and the floor cooling system in an overlapping manner to compensate for different heat expansions. The inventive construction is advantageous in that it can allow for the different ash contents of combustion and waste materials.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a